Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University)
Andheri (W), Mumbai – 400058

COURSE CONTENTS

Sem. III

S. Y. B.Tech. (ELECTRICAL) ENGINEERING

Regulation-2023 (R23)

List of Courses

Course Code	Course Name
BS-BTE301	**Laplace Transform, Vector calculus & Linear Algebra**
Course pre-requisites	DCCN(BS-BT101) , ICDE(BS-BT201)

Course Objectives

The objectives of this course are

1. To learn Laplace & Inverse Laplace transforms and its application to solve differential equations.
2. To understand concept of Vector calculus.
3. To learn various matrices, operations and important theorems.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Solve problems based on Laplace and inverse Laplace transform. Apply theory of Laplace transforms to evaluate real integrals and solve initial &boundary value problems.
2. Solve problem based on vector differentiation & vector Integration.
3. Find rank of matrices, Eigen values and Eigen vectors of matrices

Course Content

Module No.	***Details***	***Hrs.***
1	**Laplace Transforms** Function of bounded variation (Statement only) Laplace Transforms of $1, e^{at}, \sin at, \cos at, \sinh at, \cosh at, t^n, erf\left(\sqrt{t}\right), J_0(t)$,Shifting theorems, change of scale, $L\{t^n f(t)\}$, $L\left\{\frac{f(t)}{t}\right\}$, $L\left\{\frac{d^n f(t)}{dt^n}\right\}$, $L\left\{\int_0^t f(u)du\right\}$ Convolution theorem, Evaluation of real integrals using Laplace transforms.	05
2	**Inverse Laplace Transforms** Evaluation of Inverse Laplace Transforms using partial fractions, convolution theorem, shifting theorems and other properties. Application of Laplace Transform to solve initial & boundary value problems involving ordinary differential equation with one dependent variables.	05
3	**Vector Differentiation:** Introduction of Scalar point function & vector point function, Gradient, Geometrical meaning of Grad, Directional Derivative, Divergence Curl of VPF, Properties of grad divergence & Curl.	05

4	**Vector Integration -I:** Vector integrals – Line and Surface Integrals, Green theorem in plane. Problems based on work done. Conservative force field.	05
5	**Vector Integration -II:** Stoke's theorem, Gauss's Divergence theorem. Applications of Vector Integrals to Electrical engineering	05
6	**Matrices** Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian & Unitary matrices and their elementary properties. Elementary operations and their use in getting the Rank, Normalform of a matrix, PAQ form, Consistency of system of linear homogeneous and non-homogeneous equations.	04
7	**Eigen values and Cayley Hamilton Theorem** Eigen-values and Eigenvectors of a matrix, Cayley- Hamilton theorem, Function of a matrix, Diagonalization of a matrix	04
Term Work		
Term work shall comprise of A total of 10 tutorials to be taken batch wise covering the entire syllabus..		

Text Books

1. B S Grewal (2014), "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, ISBN 8174091955, 1315 Pages

Reference Books

1. Erwin Kreyszig (2010), "Advanced Engineering Mathematics" WileyEastern Limited, Singapore 10th edition, ISBN 8126554231, 1148 Pages.
2. Text book of Engineering Mathematics , N.P.Bali , Laxmi Publications, 9th edition,ISBN:978-81- 318-0832-0
3. Murray Spiegel. "Vector Analysis" Schaum's Outline Series.

Sr. No.	Examination	Module
1	T-I	1 , 2 and part of 3
2	T-II	Remaining part of 3, 4 andpart of module 5
3	End Sem	1 to 7

Course Code	Course Name
PC-BTE301	**Analog Circuits**

Course pre-requisites	Electronic circuits

Course Objectives

The objectives of this course are

1. Introduce power amplifiers and frequency response of op-amp and FET.
2. Introduction and application of 555timer and voltage regulator.
3. Introduce active filters.
4. Discuss negative feedback amplifiers and oscillators

Course Outcomes

Upon successful completion of the course, students should be able to

1. Design power amplifier to meet the desired requirement.
2. Illustrate the functions of basic building blocks of 555 timer
3. Design voltage regulators.
4. Compare circuits using negative feedback.
5. Design active filters and to select appropriate components to design oscillator

Course Content

Module No.	***Details***	***Hrs.***
1	Power Amplifiers: Introduction to different types of Large signal amplifiers viz. Class A, B, AB, C	**05**
2	Frequency response: BJT and op-amp.	**05**
3	555timer: Introduction to the block diagram, Applications: a stable and mono Stable multi vibrator with applications of each.	**05**
4	Voltage regulator: FixedVoltageregulator:78XX,79XX,AdjustableVoltageregulator:723	**07**
5	Active Filters: First and Second order LP, HP, BP & band reject filters.	**05**

6	Feedback amplifiers(Negative Feedback): Introduction to negative and positive feedback, Negative feedback Current, Voltage: Series and Shunt type Effect of Negative feedback on: Input impedance, output impedance Voltage gain, current gain and bandwidth	**08**
7	Oscillators: Frequency of oscillation, Condition for maintenance of oscillations of: (i) RC phase shift (ii)Wien Bridge, Crystal oscillator.	**07**

Text Books

1. Robert Boylestad and Louis Nashelsky, „Electronic devices and circuits“, Prentice HallofIndia, London
2. Donald A. Neamen,“ElectronicCircuitAnalysisandDesign”,TataMcGraw-Hill publishing Company Limited.
3. Gayakwad Ramakant,”Op-Amps and Linear Integrated Circuits”, PHI publication
4. K.R.Botkar,”IntegratedCircuits”,KhannaPublication.
5. David Bell,„ElectronicDevicesandCircuits“,5thEdition,OxfordUniversity Press
6. AllenMottershead,“ElectronicDevicesandCircuitsanintroduction”,Prentice Hall of India.

Reference Books

1. Bhargava, Kulshreshtha, Gupta: “Basic Electronics and Linear Circuits” NITTTR Chandigarh, 2nd edition, 2013.
2. David Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008
3. Allen Mottershead,“Electronic Devices and Circuits an introduction”, Prentice Hall of India, 1979
4. K. R. Botkar, “Integrated Circuits”, Khanna Publication, 10th edition, 1987

Sr. No.	Examination	Module
1	T-I	1,2,3
2	T-II	4,5
3	End Semester Exam	01-07

Course Code	Course Name
PC-BTE302	**Electrical Networks**

Course pre-requisites	Basic Electrical Engineering

Course Objectives
The objectives of this course are to 1. Analyze basic electrical circuits using various network theorems. 2. Analyze transient and steady state performance of RLC circuits in time domain. 3. Analyze transient and steady state performance of RLC circuits in frequency domain 4. Discuss network functions and their applications
Course Outcomes
Upon successful completion of the course, students should be able to 1. Apply network theorems for the analysis of electrical circuits. 2. Obtain transient and steady-state response of electrical circuits using time domain and frequency domain methods. 3. Determine network function of a given electrical network

Course Content

Module No.	***Details***	***Hrs.***
1	**DC Network Analysis (Steady State):** KVL, KCL, Networks with Dependent Sources, Mesh and Super-mesh analysis, Nodal and Super node analysis, Superposition theorem, Source transformation, Thevenin's theorem , Norton's theorem, Millman's theorm.	03
2	**AC Network Analysis (steady state)**: KVL, KCL, Mesh and Nodal Analysis, Superposition theorem, Source transformation, Thevenin's theorem , Norton's theorem, Maximum Power transfer theorem, series and parallel resonance.	05
3	**Solution to Differential Equations** - General and Particular solutions of first order differential equations, Properties of exponential response, Time constant, integrating factor, initial conditions, Solution of Second order differential equations.	02
4	**RL, RC, RLC Circuit Analysis (Transient) –**Initial Conditions in Network elements. Series and parallel RLC Circuit Analysis–Over-damped, critically damped and under- damped RLC circuit, Lossless LC circuits. Analysis of RLC Networks excited by external Energy Sources like step, ramp, impulse and sinusoidal source.	07

5	**Electrical Circuit Analysis Using Laplace Transform:** Review of Laplace Transform, Laplace Transform for standard inputs, inverse Laplace transform, Analysis of electrical circuits using Laplace Transform.	05
6	**Network Functions: N**etwork functions for one port and two port networks, calculation of network functions.	03
7	**Two Port Network:** Z and Y parameters, input and output impedance in terms of two port parameters, Relation between Z and Y parameters, Introduction to ABCD and h-parameters.	03

Text Books
1. M.E. Van Valkenburg: Network Analysis. Prentice-Hall of India Pvt. Limited, Eastern Economy Edition. 2. Roy Chaudhary D.: Networks &Systems, New Age International Publisher
Reference Books
1. W. H. Hayt and J. E. Kemmerly: Engineering Circuits Analysis, Tata-McGraw HILL Publicatio. 2. Chakrabarti A.: Circuit Theory (Analysis &Synthesis), Dhanpat Rai &Co. 3. Schaum's Outline Series: Electrical network. 4. M.E. Van Valkenburg: Introduction to Modern Network Synthesis, Wiley Eastern Limited

Sr. No.	Examination	Module
1	T-I	1,2,3
2	T-II	3, 4
3	End Sem	1-7

Course Code	Course Name
PC-BTE303	**Digital Electronics**

Course pre-requisites	BEE

Course Objectives

The objectives of this course are

1. Understand the number systems and coding.
2. Discuss the features of combinational circuits.
3. Understand flip flops and their applications.
4. Remember different logic families, their interfacing and memories

Course Outcomes

Upon successful completion of the course, students should be able to

1. Differentiate between number systems and classify different binary codes.
2. Analyze and design combinational circuits and Sequential circuits.
3. Solve problems using Finite state machines.
4. Classify different logic families and memories.

Course Content

Module No.	***Details***	***Hrs.***
1	Number System and Codes: Binary, Octal, Hexadecimal number systems, Conversion from one system to another, Binary Arithmetic. BCD, GRAY, Alphanumeric codes, Error detecting codes-odd and even parity, error detecting and correcting codes-Hamming Codes	**04**
2	Combinational circuits: Derive Gates, Max terms, Min terms, SOP and POS implementation, K-Maps and their use in simplifying Boolean expressions, Implementing a logic function using universal Gates.	**04**
3	Combination Logic Circuit Design: (i) Adders, Subtractors (Half and Full), carry look ahead adder, serial adder, magnitude comparators (ii) Arithmetic logic units, multiplexers, demultiplexers parity encoder, code converter. Hazards in Combinational circuits.	**08**
4	Sequential Logic Circuits: Comparison of combinational and sequential circuits, Flip-flops: SR, T, D, JK, converting one flip flop to another. Counter: Ripple counter, up-down counter, Synchronous counter, and designing of counters, state transition diagram, unused states and locked conditions.	**08**
5	Registers: SISO, SIPO, PISO, PIPO registers, ring counter, twisted ring counter, pseudorandom sequence generator.	**04**

6	Logic Families: Characteristics of digital logic families, TTL, CMOS logic, interfacing CMOS and TTL, Tri- state logic. Semiconductor memories : Content addressable memory (CAM), ROM as a PLD, Programmable logic array, Programmable array logic.	**06**
7	Introduction to finite state machine: State table, state diagram, next state analysis, Mealy and Moore state machines. State machine reduction.	**08**

For Self-Study: Memory organization and operation, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM)

Text Books
1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016
Reference Books
1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. William I. Fletcher, „An Engineering Approach to Digital Design", PHI.

Sr. No.	Examination	Module
1	T-I	1,2,3(i)
2	T-II	3(i),4
3	End Sem	01-07

Course Code	Course Name
PC-BTE304	**Electromagnetic Field and Waves**
Course pre-requisites	Basic Electrical engineering

Course Objectives

1. To introduce the basic mathematical concepts related to electromagnetic vector fields.
2. To impart knowledge on concepts of electrostatics, electric potential, energy density and its applications.
3. To impart knowledge on concepts of magneto statics, magnetic flux density, scalar and vector magnetic potential and its applications.
4. Explain time varying electric and magnetic fields and wave theory

Course Outcomes

Upon successful completion of the course, students should be able to

1. Interpret electromagnetic field data and identify the parameters that affect it.
2. Interpret and apply Maxwell's equations to analyze electromagnetic phenomena.
3. Solve problems involving the behavior of charged particles in electric and magnetic fields.
4. Apply mathematical techniques and electromagnetic field theory to analyze and design simple electromagnetic systems.

Course Content

Module No.	***Details***	***Hrs.***
1	**Review of Vector Calculus** Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, Three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, Partial differentiation, integration, vector operator del, gradient, divergence and curl, Conversion of a vector from one coordinate system to another.	06
2	**Static Electric Field** Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density	07
3	**Conductors, Dielectrics and Capacitance** Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.	06

4	**Static Magnetic Fields** Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors	07
5	**Magnetic Forces, Materials and Inductance** Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.	06
6	**Time Varying Fields and Maxwell's Equations** Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.	05
7	**Electromagnetic Waves** Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors. Poynting theorem	05

Text Books:

1. W. Hayt , "Engineering electromagnetic", 8th Edition, McGraw Hill publication, 2012
2. E. C. Jordan & K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2 nd edition, Pearson Education, 2015
3. R. K. Shevgaonkar "Electromagnetic waves" , McGraw-Hill Education (India) Pvt. Limited, 2006

Reference Books:

1. Edminister, "Schaum's series in electromagnetic",3rd Edition, McGraw Hill publications,1989
2. N. Narayan Rao, "Elements of electromagnetic",4th Edition, PHI publication, 2001
3. S. Seely, "Introduction to electromagnetic fields", McGraw Hill,1958
4. David K. Cheng, "Field and electromagnetic", 2nd Edition, Addison Wesley,1999
5. Corson and Lerrain, "Electromagnetic", 2nd Edition, CBS publications,1986

Evaluation:

Sr No.	Name of the exam	Modules
1	T-I	1,2,3
2	T-II	3,4
3	End semester examination	1-7

Analog Circuits Laboratory

Course Code	Course Name
PC-BTE351	Analog Circuits Laboratory

Course pre-requisites	Electronic Circuits

Course Objectives

The objectives of this course are

a. Study frequency response of Op-Amp and BJT, oscillators
b. Use IC 555 as mono-stable and a stable multi-vibrator.
c. Introduction to active filters, negative feedback amplifiers.
d. Learn to develop application based on digital electronics circuit

Course Outcomes

Upon successful completion of the course, students should be able to

1. Compare frequency response of Op-Amp and BJT by plotting it experimentally.
2. Able to select component values for astable and mono-stable multi-vibrators using IC 555
3. Able to use voltage regulators using IC 723, to design active filters and to select appropriate components to design oscillator.
4. Develop managerial skills

Course Content

Module No.	***Details***	***Hrs.***
1	Frequency Response of Op-amp	02
2	Astable multi-vibrator using 555	02
3	Mono-stable multi-vibrator using 555	02
4	Low voltage regulator	02
5	High voltage Regulator	02
6	First order LPF.	02
7	Wein Bridge Oscillator	02
8	RC phase shift Oscillator	02
9	Gain of CE amplifier with and without Feedback (CE bypass Capacitor)	02

Text Books

1. Robert Boylestad and Louis Nashelsky, „Electronic devices and circuits", Prentice HallofIndia, London
2. Donald A. Neamen,"ElectronicCircuitAnalysisandDesign",TataMcGraw-Hill publishing Company Limited.
3. Gayakwad Ramakant,"Op-Amps and Linear Integrated Circuits", PHI publication
4. K.R.Botkar,"IntegratedCircuits",KhannaPublication.
5. David Bell,„ElectronicDevicesandCircuits",5thEdition,OxfordUniversity Press
6. AllenMottershead,"ElectronicDevicesandCircuitsanintroduction",Prentice Hall of India.

Reference Books

1. Bhargava,Kulshreshtha,Gupta:„BasicElectronicsandLinearCircuits‟TTTI Chandigarh,Tata McGrawHill, New Delhi.
2. D. Roy Choudhari and Shail B. Jain," Linear Integrated Circuits", New age International Publishers.
3. David Bell„„ElectronicDevicesandCircuits‟,5thEdition,OxfordUniversity Press AllenMottershead,"ElectronicDevicesandCircuitsanintroduction",Prentice Hall of India

Course Code	Course Name
PC-BTE352	**Electrical Network Laboratory**
Course pre-requisites	Basic Electrical Engineering

Course Objectives

The objectives of this course are

1. Introduction to MATLAB / SCILAB/ e-sim/ Pspice/ SEQUEL software for circuit analysis.
2. To simulate electrical circuits using simulation software.
3. Gain practical experience on simulation and working of electrical circuits.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Evaluate steady state and transient state response of DC and AC electrical circuits.
2. Analyze DC/AC electrical circuits through simulation software.
3. Analyze DC/AC electrical circuits through experimental setup.

Course Content

Module No.	***Details***	***Hrs.***
1	DC network Simulation	02
2	AC network Simulation-I	02
3	AC network Simulation-II (with dependent source)	02
4	Transient Response of RL, RC and RLC network for step input voltage (through Simulation)	02
5	Transient and steady state Response of RL, RC and RLC network for sinusoidal input voltage (through Simulation)	02
6	Transient Response of RL, RC and RLC network using hardware setup.	02
7	Series resonance	02
8	Obtaining response of a given electrical network using transfer function (Code).	02
9	Pole – zero plot of a given transfer function	02

List of Class Assignments

1	DC networks Theorems
2	AC networks Theorems
3	Time domain analysis of RLC circuits
4	Laplace Transform and analysis of RLC circuits
5	Network functions and two port networks

Reference Books
1. M.E. Van Valkenburg: Network Analysis. Prentice-Hall of IndiaPvt. Limited, Eastern Economy Edition. 2. Roy Chaudhary D.: Networks &Systems, New Age international publisher 3. W. H. Hayt,and J. E. Kemmerly: Engineering Circuits Analysis, Tata-McGraw HILL Publication. 4. Chakrabarti A.: Circuit Theory (Analysis &Synthesis), Dhanpat Rai &Co. 5. Schaum‟s Outline Series: Electrical network. 6. M.E. Van Valkenburg: Introduction to Modern Network Synthesis, Wiley Eastern Limited

Course Code	Course Name
PC-BTE353	**Digital Electronics Laboratory**
Course pre-requisites	

Course Objectives

The objectives of this course are

1. Understand the basics of circuit making on bread board
2. Test the working of the circuit
3. Introduce simulation using software
4. Learn to develop application based on digital electronics circuits.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Design combinational and sequential circuits using discrete components.
2. Test the designed circuit to get required output.
3. Simulate complex combinational and sequential circuits.
4. Write and present project report in a team.

Course Content

Module No.	***Details***	***Hrs.***
1	Logic Expressions simplification and implementation.	02
2	Half Adder and Half subtractor using gate IC‟s	02
3	Code Converter: Binary to Gray, BCD to XS-3.	02
4	IC7483 as 4bit adder and subtractor	02
5	Multiplexer 4:1 using gates.	02
6	Simulate De-multiplexer1:16 internal Gate circuit.	02
7	Flip-Flops: S-R, J-K, D, T using gates.	02
8	BCD Counter implementation using Flip Flops.	02
9	Simulation of Ring Counter, Twisted Ring Counter.	02
10	PLD Simulation	02

Text Books

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016

Reference Books

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. William I. Fletcher, „An Engineering Approach to Digital Design‟, PHI.

Course Code	Course Name
PC-BTE354	**Electromagnetic Field and Waves Laboratory**
Course pre-requisites	

Course Objectives

The objectives of this course are

1. To understand and concept of vector addition, vector calculus, co-ordinate systems, static and time varying fields and electromagnetic waves more precisely by visualize aid.
2. To familiarize the students by introducing FEMM-4.2 simulation software and help them to Simulate and analyze different Electromagnetic circuit

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand concepts of vector calculus and underlying theories in electrostatics, magneto statics, and time-varying electromagnetic fields using field plots generated by formulae and Finite Element Method (FEM) based computations.
2. Apply knowledge of electromagnetic fields in real time application.
3. Analysis of effect electromagnetic field in electromagnetic circuits.
4. Build and simulate core electromagnetic circuits and power apparatus using FEMM S/W.

Course Content

Module No.	***Details***	***Hrs.***
1	Addition & Products of two vectors.	02
2	Coordinate systems (Cartesian, Cylindrical and Spherical).	02
3	Position vector and distance vector.	02
4	Curl, Divergence and gradient of a field.	02
5	Variation of electrostatic fields.	02
6	Curl free static electric field.	02
7	Variation of electrostatic fields over multiple dielectric materials.	02
8	Electric flux density.	02
9	Force on a single current carrying conductor.	02
10	Force between two current carrying conductors.	02
11	Magnetic vector potential.	02
12	Variations of time varying field.	02

Text Books

1. W.Hayt, “Engineering electromagnetic”, McGraw Hill.
2. E.C.Jordan &K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, Prentice Hall of India.

Reference Books

1. Edminister, “Schaum’s series in electromagnetic”, McGraw Hill publications.
2. N.NarayanRao, “Elements of electromagnetic”, PHI publication.
3. S.seely, “Introduction to electromagnetic fields”, McGraw Hill.
4. David K. cheng, “Field and electromagnetic”, Addison Wesley.
5. Corson and lerrain, “Electromagnetic”, CBS publications

Value Education Course- Environmental Science and Sustainability

Course Code	Course Name
VE-BTE001	Environmental Science

Course pre-requisites	

Course Objectives

The objectives of this course are

1. To sensitize to the ever-increasing environment problems.
2. To acquire knowledge about environmental pollution.
3. To acquire knowledge with respect to renewable energy and its positive impact on environment.
4. To be aware of the national and international concern for environment for protecting the environment.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand the requirement of environment science and sustainability and apply it in the field of electrical engineering
2. Propose specifications to comply with norms of environment engineering
3. Describe laws and regulations pertaining to health, safety and environment
4. Apply evaluation tool such as GRIHA to help design, build, operate, and maintain a resource efficient environment management system

Course Content

Module No.	*Details*	*Hrs.*
1	**Introduction to Environmental Science and Pollution**: Biotic and Abiotic Environment, Adverse effects of environment, Types of environmental pollution Pollution - Water pollution, Air pollution, Solid waste management, Control Strategies of different environmental problems	05
2	**Introduction to Renewable Energy:** Solar, Wind, Geothermal, Ocean (Tidal), Biomass–Basics, Conservation of natural resources. Environmental and economic impact of each type of renewable energy, Energy Management	07
3	**Sustainability and Sustainable Energy Management**: Introduction to Sustainaility, sustainable strategies, Sustainable technologies, green commodities, Carbon credits, carbon emission monitoring, introduction to energy audit	06
4	**Hazard Assessment, Prevention, and Control:** Stress and Safety, Safety and Health Training, Mechanical Hazards and Machine Safeguarding, Fire Hazards and Life Safety, Ethics and Safety, Hazard Analysis/Prevention and Safety Management, Environmental Safety and ISO 14000 (Environmental Management).	05
5	**Introduction to National Rating System** GRIHA (Green Rating	05

	For Integrated Habitat Assessment): An evaluation tool to help design, build, operate, and maintain a resource-efficient built environment. Case studies of GRIHA registered buildings	

Text Books
1. Jagdish Krishnawamy, R J Ranjit Daniels,“ Environmental Studies”, Wiley India Private Ltd. New Delhi. 4. An Indita Basak, Environmental S
Reference Books
1. GRIHA Manual Volume 1 - Ministry of New and Renewable Energy, Government of India, New Delhi. 2. ISO 14001:2004(E) - Environmental management systems Requirements with guidance for use.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute under Mumbai University)
Andheri (W), Mumbai – 400058

COURSE CONTENTS

Sem. IV

S. Y. B.Tech. (ELECTRICAL) ENGINEERING

Regulation 2023(R23)

List of Courses

Course Code	Course Name
BS-BTE401	**Transforms, Statistics and Probability**

Course pre-requisites	DCCN(BS-BT101) , ICDE(BS-BT201) , LVCLA(BS-BTE301)

Course Objectives

The objectives of this course are

1. Introduce Fourier series
2. Introduce Fourier transforms & Z-transforms
3. Introduce Hypothesis testing
4. Introduce Statistical methods, probability distribution

Course Outcomes

Upon successful completion of the course, students should be able

1. Solve problems on Fourier series
2. Solve problems based on Fourier transforms & Z-transforms
3. Solve problem in basic statistics, probability, probability distribution
4. Solve problems based on testing of hypothesis

Course Content

Module No.	***Details***	***Hrs.***
1	**Fourier Series & Integrals** Orthogonal & Orthonormal set of functions. Fourier series, Determination of Fourier constants, Dirichlets conditions. Fourier series for $f(x)$, $x \in [c, c+2\pi]$ and $x \in [c, c+2L]$, Parseval's Identity. **Fourier Series half range & complex form** Fourier series of Odd and Even functions Half range Fourier Sine & Cosine series, Parseval's Identity Complex form of Fourier series	04
2	**Fourier Transform** Fourier Integral theorem. Fourier Sine and Cosine integrals. Inversion formulae of Fourier transform.	04
3	**Statistics:** Correlation, Karl Pearson coefficient &Spearman's rank Correlation coefficient, linear regression, lines of regression.	04
4	**Discrete Random Variables:** Random variables, Probability distribution for discrete random variables, Expected value and Variance, Binomial Distribution and Poisson Distribution	04
5	**Continuous Random Variables:** Probability Density Function for continuous random variable, Normal Distribution	04
6	**Sampling Theory:** Sampling distribution. Test of Hypothesis. Level of significance, critical region. Large and Small Samples. Test of significance for Large Samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Test for significance of the difference between sample S.D and population S.D, Test for significance of the difference between the S.D of two samples.	04
7	**T-Test:** Student's t-distribution and its properties. Test of significance of small samples. Test for significance of the difference between sample mean and population means, Test for significance of	04

	the difference between the means of two samples, Chi-square distribution and its properties.	

Term Work

Term work shall comprise of
A total of 10 tutorials to be taken batch wise covering the entire syllabus.

Text Books

1. B S Grewal, "Higher Engineering Mathematics", Khanna Publications.
2. H.K.Das. "Advanced Engineering Mathematics", S.Chand Publication.
3. Murray Spiegel. "Probability and Statistics" Schaum's Outline Series.

Reference Books

1. B. V. Ramanna. "Higher Engineering Mathematics" Tata Mc-Graw Hill Publication.
2. N.P.Bali. "Text book of Engineering Mathematics", Laxmi Publications.
3. R. K. Jain and S.R.K. Iyenger. "Advanced Engineering Mathematics", Narosa Publication.

Sr. No.	Examination	Module
1	T-I	1, 2
2	T-II	3, 4
3	End Sem	1 to 7

Course Code	Course Name
PC-BTE401	**Power Generation, Transmission & Distribution**
Course pre-requisites	Basic Electrical Engineering, Electrical Network

Course Objectives

The objectives of this course are

1. To make student understand basic structure and requirements of any electric power supply system.
2. To impart knowledge about modelling of various power system components.
3. To make student realize the need of earthing & safety techniques

Course Outcomes

At the end of the course, students will demonstrate the ability to

1. Explain structure of power system, load patterns and various generation, storage techniques.
2. Model power system equipments and evaluate their performance under steady state.
3. Understand and appreciate the need of earthing and neutral grounding for power system equipments.
4. Identify various components and structure of distribution system.

Course Content

Module No.	*Details*	*Hrs.*
1	**Basic structure of power system:** Single Line diagram, Generation, transmission and distribution voltage levels, Power system scenario in India, concept of regional and National GRID. **Review of AC systems:** Complex power in single phase and three phase systems, power factor correction, Star and delta connections, phasor diagram for balanced and unbalanced load. **Basic Economics of power system:** Load curves, connected load, maximum demand, demand factor, Average load, load factor, diversity factor, Tariff, Introduction to demand side management.	4
2	**Energy Generation & Storage-** overview and comparative study of conventional and renewable power generation, Environmental and economic impact. Battery storage, types of batteries, different battery materials, Mechanical storage (flywheel, pump storage, PHS &CAES), Electrostatic & electromagnetic storage, UPS.	6
3	**Transmission Systems:** Transmission line resistance and shunt conductance, skin effect, proximity Effect, Electrical and Magnetic Fields around conductors, Corona Effect, Inductance and capacitance calculations for different configurations of single phase and three phase line with composite & bundled conductors. Cables and wires: theory, design and construction, cable laying methods, concept of cable derating.	6

4	**Models and Performance of Transmission Line:** Steady state representation of lines: short, medium and long line models and performance evaluation, voltage and current waves, surge impedance loading (SIL), concept of lossless line, voltage, current profiles under different loading conditions, Ferranti Effect, shunt and series compensation.	8
5	**Modelling of Transformer, Synchronous Machine & Loads:** Steady state representation of power transformer: Three-phase connections and star delta phase-shifts. Single phase equivalent of three-phase transformers. Three-winding transformers, autotransformers, Synchronous Machine: equivalent circuit, operation when connected to infinite bus, power angle characteristics. Load models : constant power, constant current & constant impedance loads	6
6	**Earthing & Neutral Grounding in power system:** Soil resistivity, earth resistance, Tolerable limit of body currents- tolerable step and touch voltage-actual step and touch voltage, Design of earthing grid-concrete encased electrodes and tower footing Resistance, Measurement of earth resistance, soil resistivity, Impulse behavior of Earthing. Overvoltage due to ungrounded neutral, methods of neutral grounding.	6
7	**Electrical Distribution Systems** Structure of Distribution System, Components of Distribution System Substation and Busbar Layouts, Feeder Configurations, Nature of Loads in a Distribution System, Distribution transformer loading, various Load Allocation techniques.	6

For Self-study: Mechanical Design of O/H Transmission systems:
Types of towers, conductor configuration, spacing and clearance, span lengths, sag & tension, Types of insulator, Voltage distribution over insulator string, methods to improve string efficiency.

Text Books:

1. Saadat Hadi, “Power System Analysis, “TMH Publication.
2. Kothari D. P Nagrath I. J., “Modern Power System Analysis”, TMH Publications.
3. Wadhawa C. L., “Electrical Power Systems”, New Age International.
4. B. R. Gupta, “Power system Analysis and Design”, S. Chand Publications
5. A. A. Sallam and O. P. Malik, “Electric Distribution System”, IEEE Press, Piscataway, NJ, 2011.

Reference Books:

1. Prabha Kundur, “Power System Stability and Control’’, TMH Publication.
2. Olle I. Elgerd, “Electric Energy Systems Theory: an Introduction”, TMH Publication
3. IEEE 80 – IEEE guide for safety in substation grounding
4. Dr. K. Rajamani, “Application Guide for Power Engineers Part 1 Earthing & Grounding of Electrical systems”, Notion Press.
5. W. H. Kresting, “Distribution System Modeling and Analysis”, CRC Press, New York, 2002.

Course Code	Course Name
PC-BTE402	**Measurements and Instrumentation**
Course pre-requisites	Basic Electrical Engineering, Electrical networks, Signals and systems

Course Objectives

The objectives of this course are

1. Understanding the basic principles of electrical and electronic measurement, including units of measurement and calibration procedures.
2. Familiarizing students with common types of measurement devices, such as multi-meter, oscilloscopes, signal generators, and frequency counters.
3. Developing skills in the use of measurement equipment, including measurement setup, measurement execution, and data analysis.
4. Developing the ability to analyze and interpret measurement data, and to draw meaningful conclusions from it.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply the basics of electrical and electronics for analog signal measurement.
2. Interpret measurement data and identify source of errors in measurement.
3. Apply the knowledge of digital techniques in measuring instruments.
4. Apply calibration techniques and standards of measurements to ensure accuracy of measurement instruments.

Course Content

Module No.	***Details***	***Hrs.***
1	**Basics of Measurements** Analog measuring instruments, General features of indicating, recording and integrating type of instruments, Errors in measurements	04
2	**Measurement of electrical quantities** Measurement of current, voltage and Energy, Measurement of power in balanced and unbalanced electrical systems. **Measurement of electrical parameters** Measurement of low, medium and high resistance, insulation resistance, earth resistance, Wheatstone bridge, Kelvin double bridge, Megger, AC bridges for measurement of inductance and capacitance.	09
3	**Instrument transformer** Theory of Current and potential transformers, Definition, various types, importance and applications, ratings, Definition of ratio and phase angle errors, LEM sensors, CCVT	06

4	**Instruments for generation and analysis of waveforms** Oscillator: Wein bridge oscillator, Phase shift oscillator, Standard signal generator, Function generator, Wave analyzer, Harmonic distortion analyzer, Spectrum analyzer, Cathode ray oscilloscope: time, frequency and phase angle measurement using CRO.	07
5	**Digital Instruments** Analog to digital conversion, sampling theorem, Digital measurement technique, Digital frequency meter, Digital voltmeters (DVM). Digital Storage Oscilloscope, Errors in digital measurement, Data logger, Digital sensors e.g. Sensors in solar PV system,	06
6	**Transducers& basic Instrumentation** Measurement of temperature, vibration, velocity (speed), flow, level, Photoelectric, strain gauge, Characteristics and selection for given Application	05
7	**Calibration of Instruments and Safety in instrumentation** Need of Instrument Calibration, Preparation for calibration, Standard calibration procedure, Five point calibration procedure, Safety in instrumentation, Standards for measurement (IEC 62419)	05

Text Books:

1. Sawhney A.K. "A course in Electrical and electronics measurements and Instrumentation" by Dhanpat Rai and Sons, 17th edition 2007.
2. T.S. Rathore, "Digital measurement techniques" by Narosa Publishing house, 1996

Reference Books:

1. Kalsi H.S. "Electronic Instrumentation", 3rd edition, Tata McGraw Hill, 1997.
2. Doeblin E.O., "Measurement system application and design", 4th edition, Tata McGraw Hill, 1990

Evaluation:

Sr No.	Name of the exam	Modules
1	T-I	1,2,3
2	T-II	3,4
3	End semester examination	1-7

Course Code	Course Name
PC-BTE 403	**Electrical Machines-I**
Course pre-requisites	Electromagnetic field theory, Electrical Networks

Course Objectives

1. Discuss the concepts of magnetic field, magnetic circuits, electromagnetic force and torque.
2. Comprehensive analysis of DC machines and transformers

Course Outcomes

1. Apply the concepts of magnetic circuits in rotating machine and transformers.
2. Examine the differences in operation of different dc machine configurations.
3. Analyze and evaluate the performance of different transformers

Course Content

Module No.	***Details***	***Hrs.***
1	Magnetic fields and magnetic circuits: Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.	4
2	Electromagnetic force and torque: B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits	3
3	Linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element.	4
4	DC machines : EMF equation, Armature winding and commutation- Derivation of torque equation, armature reaction	4
5	DC machine - motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, V-I characteristics and torque-speed characteristics of DC machines. **Factors affecting machine performance.**	6
6	Transformers: Principle of operation of single phase and three phase transformers, Equivalent circuit, Phasor diagram, O.C. and S.C. test: Efficiency and regulation, Transformer Vector Groups, Parallel operation of transformers	11
7	Excitation phenomenon in transformers: Transformer harmonics, Oscillating neutral, Transformer switching current transient, Autotransformers, Tap changing transformers. High Frequency Transformers (HFT): Basic Principle - construction – Application of HFT. Factors affecting machine transformer performance.	10

For Self-study: Different types of HFT and their constructions and comparison

E resources: http://www.digimat.in/nptel/courses/video/108102146/L01.html

Text Books:

1. P.C.Sen, Principles of Electric Machines and Power Electronics Wiley India Pvt Ltd.
2. A. E. Fitzgerald, Charles Kingsley, Jr., Stephen D. Umans 'Electric Machinery', McGraw Hill, sixth edition
3. P.S.Bimbra, 'Electrical Machinery', by Khanna Publisher
4. Nagrath I. J., Kothari D.P., 'Electric Machines', TMH Publication.

Reference Books:

1. P.S. Bimbra, 'Generalized theory of Electrical Machines', Khanna Publisher..
2. Ashfaq Husain,' Electric Machines', Dhanpat Rai and Sons, second edition, 2017

Course Code	Course Name
PC-BTE404	**Microprocessor and Microcontroller**

Course pre-requisites	Digital Electronics

Course Objectives

The objectives of this course are

1. To understand the difference between of Microprocessors & Microcontrollers
2. To understand architecture and features of typical Microcontroller.
3. To learn interfacing of memory and I/O.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Explain The 8051 Architecture
2. Know various instructions, addressing modes and hence do assembly language programming.
3. Be able to do interfacing of peripherals with microcontroller.

Course Content

Module No.	***Details***	***Hrs.***
1	**Fundamentals of Microprocessors:** Fundamentals of Microprocessor Architecture. 8- bit Microprocessor and Microcontroller architecture, Comparison of 8-bit, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.	06
2	**The 8051 Architecture** Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles	06
3	**Instruction Set and Programming I** Addressing modes: Introduction, Instruction syntax, Data addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set,	06

4	**Instruction Set and Programming II** Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.	06
5	**Memory and I/O Interfacing** Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices	08
6	External Communication Interface Synchronous and Asynchronous Communication. RS232, SPI, I2C.	05
7	**Applications** LED, LCD and keyboard interfacing. Stepper motor interfacing.	05

For Self-Study : Applications of 8051 DC Motor interfacing and sensor interfacing
Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Text Books

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and applications with 8085", Penram International Publication 6th edition, 2013.
2. Muhammad Ali Mazidi, "The 8051 Microcontrollers and Embedded Systems using Assembly and C", Pearson 2nd edition, .2007

Reference Books

1. Mano M., "Computer System and Architecture", Pearson, 3rd edition, 2017.
2. William Stallings, " Computer Organization and Architecture", Pearson, 11th edition, 2022
3. A K Ray, K M Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 3rd h edition, 2017
4. Kenneth J .Ayala," The 8051 Microcontroller Architecture, Programming, and applications ", Penram Publishers, 1991

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	01-07

Course Code	Course Name
PC-BTE405	**Signals and Systems**

Course pre-requisites	Basic Electrical Engineering, Laplace Transform, Fourier Series

Course Objectives

The objectives of this course are

1. To introduce the concepts of signals and systems.
2. To discuss different analysis tools (Fourier Series, Fourier Transform, Laplace Transform and Z Transform) and their properties.
3. To carry out analysis and synthesis of both continuous-time and discrete time systems both in time domain and transformed domain using different transforms and applied mathematics concepts

Course Outcomes

Upon successful completion of the course, students should be able to

1. Characterize CT and DT signals and systems.
2. Analyze DT systems in Time domain and using Z-Transform.
3. Analyze CT signals using Fourier analysis tools, CTFS and CTFT.
4. Analyze CT system using Fourier and Laplace transform.

Course Content

Mod No.	*Details*	*Hrs.*
1	**Introduction to Signals and Systems** Definition of basic signals such as impulse, unit step, unit ramp, Analog to digital conversion of signal, basic discrete time signals. Classification of signals, Signal operations, Signal RMS and average value. Concept of a Continuous time (CT) and Discrete time(DT) system, properties and classification of systems, Examples of CT and DT system models, modeling of electrical circuit models such as RL circuit.	06
2	**Discrete time LTI Systems** Introduction FIR and IIR Systems, Discrete convolution and correlation, properties of convolution, Solution of linear constant coefficient difference equation, Zero input and zero state response.	06
3	**Fourier Series and Fourier Transform** Introduction, Trigonometric and exponential Fourier Series, Parseval's theorem for Fourier Series, Power Spectrum of a Periodic Function. Fourier Transform, Properties of Fourier Transform such as Linearity, Symmetry, Scaling, Convolution, Time shifting, Frequency shifting, Fourier transform of some important signals such as rectangular, triangular, exponential, Gaussian pulse, energy spectrum. System analysis of CT system, frequency response of a CT system, Introduction to DTFS and DTFT.	06

4	**Laplace Transform & its applications to System Analysis** Introduction, Definition, ROC, Laplace Transform of basic signals, Laplace transform of periodic signals, Initial and Final value theorem, Partial fraction expansions, application to system analysis, transfer function, poles and zeros, stability in s-domain.	06
5	Z-Transform Introduction, Definition, one sided and two sided z-transform, ROC, Properties of ROC, Properties of z-transform. Inverse z- Transform using methods such as long division, partial fraction expansion and residue method.	06
6	Analysis of LTI systems using z-Transform Solution of linear constant coefficient difference equation using method of z-Transform, transfer function, impulse response and step response, Pole - zero concepts, stability criterion for systems, Relation between s- plane and z-plane.	06
7	Realization of Linear Systems Basic realization block diagram of CT and DT system. Basic structures of FIR Systems Basic structures for IIR Systems: Direct form – I, direct form – II, series, parallel.	06

Self Study- Applications of signals and systems in real life.

Text Books
1. Alan V. Oppenheim, Alan V. Willsky and S.Hamid Nawab, “Signals and Systems”, Prentice-Hall India. 2. Mrinal Mandal and Amir Asif, “Continous and Discrete Time Signals and Systems”, Cambrige International Student Edition, Tata McGraw-Hill. 3. Haykin S and Van Veen B., “Signal & Systems”, Wiley Publication, 2nd Ed.,2002. 4. Hwei P. Hsu, SCHAUM'S OUTLINES OF “Theory and Problems of Signals and Systems”, McGraw-Hill International.
Reference Books
1. Nagrath I. J., Sharan S. N. and Ranjan R., “Signal & Systems”, 2nd Ed., 2010. 2. Narayan Iyer, “Signal & Systems”, Cengage Learning, 2011. 3. Lindner D.K., “Introduction to Signal & Systems”, McGraw-Hill International Edition, 1999. 4. Ambardar, “Analog & Digital Signal Processing”, Thomson learning, 2nd Ed. 5. Proakis J.G. and Manolakis D. G., “Digital Signal Processing: Principles, Algorithms and applications”, PHI publications (1995). 6. Lathi B.P., “Signal & Systems”, Oxford University Press, second edition, 1998.

Sr. No.	Examination	Module
1	T-I	1,2,3
2	T-II	3, 4
3	End Sem	1-7

Course Code	Course Name
PC-BTE452	**Measurement and Instrumentation Laboratory**

Course pre-requisites	Electronic Circuits and Digital Electronics

Course Objectives

The objectives of this course are

1. To conduct experiment on calibration of energy meter
2. To understand different in-built Lab view result functions related to signals and system.
3. To validate the theoretical concept

Course Outcomes

Upon successful completion of the course, students should be able to

1. Understand construction and working principle of various analog instruments.
2. Understand various measurement techniques used for measurement of various parameters.
3. Apply theoretical knowledge to convert analog signal into digital signal.

Course Content

Module No.	***Details***	***Hrs.***
1	To measure the energy consumed by load using analog energy meter and compare the measurement with static energy meter. Wattmeter.	02
2	Study of Moving iron, PMMC and Dynamometer type instruments (Basic moving systems).	02
3	To study the working of Megger and carry out measurement of insulation resistance.	02
4	Study of construction of LVDT and measurement of displacement, force and pressure by using it.	02
5	Measurement of R, L and C Using Different Bridges and confirmation with analytical calculations.	02
6	Comparative study of temperature measurement using RTD and thermocouple.	02
7	To measure input voltage signal using Voltage to Frequency Converter using IC 555	02
8	Study of Cathode Ray Oscilloscope	02
9	Speed measurement using photoelectric pick up, magnetic pick up and stroboscope.	02
10	Measurement of power in three phase balanced and unbalanced circuits by conventional two wattmeter method and by power analyzer.	2
11	Demonstration of current transformer and potential transformer	02

Text Books
1. Sawhney. A.K., "A course in Electrical and electronics measurements and Instrumentation" by Dhanpat Rai and Sons 17th edition 2007. 2. T.S. Rathore, "Digital measurement techniques", by Narosa Publishing house
Reference Books
1. Kalsi H.S. "Electronic Instrumentation", Tata McGraw Hill, 3rd edition 1997. 2. Doeblin E.O, "Measurement system application and design", Tata McGraw Hill, 4th edition 1990

Course Code	Course Name
PC-BTE 453	**Electrical Machines-I Lab**
Course pre-requisites	Basics of Electrical Engineering

Course Objectives

1. Understand concepts of electromagnetics through simulations
2. Demonstrate construction of different machines.
3. Conduct experiment to evaluate performance of single phase and three phase transformer.
4. Conduct experiment to evaluate performance of DC shunt motor

Course Outcomes

1. Verify concepts of electromagnetics using software simulation
2. Determine the performance characteristics of DC machines
3. Evaluate the performance of transformer.
4. Observe the effect of load variation on the performance of DC motor and transformer

Course Content

Expt. No.	***Details***	***Hrs.***
1.	Simulation 1 based on Magnetic fields and magnetic circuits	2
2.	Simulation 2 based on Electromagnetic force and torque	2
3.	Demonstration on construction of transformer and DC machines	2
4.	To study speed control of DC Shunt Motor	2
5.	To perform load test on DC Shunt Motor.	2
6.	To study speed control of DC Series Motor	2
7.	To perform open circuit and short circuit test on 1 Phase Transformer	2
8.	To perform load test on 1 Phase Transformer	2
9.	To perform open circuit and short circuit test on 3 Phase Transformer	2
10.	To study parallel operation of two single phase transformer.	2
11.	To connect two winding transformer as a autotransformer	2
12.	General machine model for developing different kind of machines	2

Reference Books:

1. P.C.Sen, Principles of Electric Machines and Power Electronics Wiley India Pvt Ltd.
2. A. E. Fitzgerald, Charles Kingsley, Jr., Stephen D. Umans ‘Electric Machinery’, McGraw Hill, sixth edition
3. P.S.Bimbra, ‘Electrical Machinery’, by Khanna Publisher
4. NagrathI.J., Kothari D.P., ‘Electric Machines’, TMH Publication.
5. P.S.Bimbra, ‘Generalized theory of Electrical Machines’, Khanna Publisher.

Course Code	**Course Name**
PC-BTE454	**Microprocessor and Microcontroller Laboratory**
Course pre-requisites	Digital Electronics

Course Objectives

The objectives of this course are

1. Study of instruction set and architecture of microprocessor and Microcontroller.
2. Study of external interface.
3. Learn to develop applications using microprocessor/ microcontroller.

Course Outcomes

Upon successful completion of the course, students should be able to

1. Apply instruction set of microprocessor and Microcontroller.
2. Interface with external devices.
3. Write and present project report in a team.

Course Content

Module No.	***Details***	***Hrs.***
	Microprocessor	
1	Addition of Two 8-bit Numbers and Sum is 8-bit.	02
2	Addition of two 8 bit numbers and sum is 16-bit.	
3	Addition of Two 16-Bit Numbers and Sum is 16-bit.	
4	Decimal Addition of Two 8-Bit Numbers and Sum is 8-bit.	02
5	One's Complement and Two's Complement of an 8-bit Number	
	Microcontroller	
6	To add and subtract two 8 bit numbers using registers.	02
7	To multiply and divide two 8 bit numbers using register.	
8	Addition and subtraction of two numbers using DPTR.	02
9	Multiply and divide two numbers using DPTR.	
10	Count number of ones in a 8 bit number, maximum and minimum of numbers	02
11	Ascending /Descending order.	02
12	To perform read and write operation by 8255 interfacing	02
13	Interfacing of microcontroller to seven segment display.	02
14	Interfacing of microcontroller to D/A converters.	02

Text Books

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and applications with 8085", Penram International Publication 6th edition, 2013.
2. Muhammad Ali Mazidi, "The 8051 Microcontrollers and Embedded Systems using Assembly and C", Pearson 2nd edition, .2007